California Class II Aquifer Exemption Request
Completeness Check/Preliminary Review

Project: West Tejon Field (also referred to as Tejon Field, Western Area)

Key to tables: Each row in the tables below describes a piece of information that EPA will need to evaluate to determine whether the aquifer exemption request meets the criteria at 40 CFR 146.4. EPA reviewed the application and associated information, evaluated whether the information was provided and complete, and performed a preliminary evaluation of whether the information submitted appears to be sufficiently robust to inform a determination regarding the aquifer exemption. EPA recorded its findings as follows:

- "Submitted and complete" means that the aquifer exemption request included information on which to evaluate the specific aspect of the criteria (and the relevant information is summarized in the table).
- "Submitted and complete, but not sufficient" means that the aquifer exemption request included some information on which to evaluate the specific aspect of the criteria, but this information appears to be insufficient to support a full technical evaluation on which to base a determination. The table includes a brief discussion of why the material appears to be insufficient.
- "Incomplete" means that the applicant submitted some information, but it is incomplete. EPA requests specific clarification or additional information in these rows of the table.
- "Not provided" means that EPA found nothing in the request that addressed the item.
- "TBD" (to be determined) and "No further action needed" are used for items related to the public engagement process, where the complete/incomplete/not provided designation does not apply.

General Project and Aquifer Information

General Information	Submitted and complete? (If incomplete, describe information needed)
Owner/operator name	**Submitted and complete** Vintage Production California (VPC) LLC
Well/project name	**Submitted and complete** West Tejon Field (also referred to as Tejon Oil Field, Western Area)
API number(s)	**Submitted and complete** API numbers of active production and injection wells in the Transition Zone are provided in Table 5 of the application.
Well Class (and subtype)	**Submitted and complete, but not sufficient** Class II, WD and EOR. Various sections of the application refer to water disposal and/or enhanced recovery; e.g., p. 1-1 states "As of September 2015, the project contains Class II injection wells for secondary recovery of oil" while p. 1 of DOGGR's Statement of Basis states that the well class is "Class II, Water Disposal and Enhanced Oil Recovery." Please clarify whether there are both WD and EOR wells in the area proposed for exemption.
Purpose of Injection	**Submitted and complete**

	According to the application's Executive Summary of the application, there are 76 active producing wells in the Transition Zone aquifer and 9 active Class II injection wells (which reinject separated produced water back into the Transition Zone).
Where is the proposed aquifer exemption located?	**Submitted and complete, but not sufficient** A site location map is provided in Figure 1 of the application. Specific geospatial information on the proposed area (e.g., provided in GIS shapefiles/polygons) is needed to clearly define the boundaries of the exempted area and to support EPA HQ's effort to make this information available to the public.
Township, Section, Range, Quarter	**Submitted and complete** Per p. 1-1 of the application, the proposed exemption area is located in Sections 31, 32, and 33 of T. 11 N., R. 19 W.) and Sections 4, 5, and 6 of T. 10 N., R. 19 W., San Bernardino meridian.
Latitude and longitude Information	**Submitted and complete** Per p. 1-1 of the application, the proposed exemption area is bounded by the following coordinates: • Northwest corner: 35.004936, -118.955348 • Northeast corner: 35.001796, -118.899025 • Southeast corner: 34.969811, -118.899374 • Southwest corner: 34.969916, -118.952699
County and City	**Submitted and complete** Kern County, southern San Joaquin Valley (unincorporated area).
Information about distance to nearest Town and/or County	**Incomplete** DOGGR's Statement of Basis (p. 2) states that the area is approximately 25 miles south of Bakersfield. The nearest public water supply well is 0.9 mi north of the area proposed for exemption (Tejon Ranch; Well ID 1 on the aforementioned map and table). The application does not specify the nearest populated area, though Google Maps and other publically available sources indicate that there is some nearby commercial and residential development. Please clarify the name and water supply of the nearest populated area (see also "Table of inventoried water wells…" below).
Name of the aquifer or portion of the aquifer to be exempted	**Submitted and complete** The aquifer to be exempted is referred to as the Transition Zone (the basal portion of the Chanac Formation, as stated in the application's Executive Summary).
Areal extent of the area proposed for exemption	**Submitted and complete** The areal extent of the proposed exemption area is approximately 1,300 acres (2.04 mi^2), per pg. 2-1 of application. The new area proposed for exemption adds approximately 565 acres (0.88 mi^2) to the areal extent of the existing aquifer exemption, per pg. 1-1 of the application. The lateral boundaries of the area to be exemption are defined by the surface expression of the -1,690 ft total vertical subsea

	depth (TVSS) contour line (see "Project Description" below for further information).
Depth and thickness of the aquifer	**Submitted and complete** As stated on pg. 2-1 of the application, the highest elevation at the top of the Transition Zone is approximately -1,465 ft TVSS, or approximately 2,533 ft below ground surface (bgs). The Transition Zone averages approximately 235 feet thick within the exemption area, shown in Figures 2 and 8. Figures 4 through 6 contain cross-sections and well log results showing the vertical extent of the unit and its oil- and water-bearing components.
Information on the TDS content of the aquifer, including the TDS at the top and bottom of the exempted zone, and the locations and depths of all fluid samples taken	**Submitted and complete, but not sufficient** TDS data provided in Table 3 of the application range from 2,221.1 to 3,317 mg/L, but the corresponding sampling depths do not have units. The table indicates "Completion Depth (MD)," but the values for MD (measured depth) are unitless and range from 17 to 21.8. Please clarify the sampling depths cited for TDS measurements in Table 3 of the application.
Substantial or non-substantial?	**TBD**
Describe the basis for substantial/non-substantial determination	**TBD**
Did DOGRR provide public notice and opportunity for public hearing on the AE request? (40 CFR 144.7)	**TBD** As of August 8, 2016, this aquifer exemption application has not yet been posted on the DOGGR website.
Were there any public comments?	**TBD**
If so, where are these public comments located?	**TBD**
Dates of public notices published	**TBD**
Dates of public meetings or hearings held	**TBD**
Were there any notable findings or pending litigation?	**TBD**
Description of the notice and comment process and the state's final decision	**TBD**
Basis for the decision to exempt the aquifer or withhold or deny the request	**TBD**

Any anticipated issues associated with EPA approval or disapproval of the AE request?	TBD	
Any meetings between EPA/State/Tribes/Operator to discuss issues. If so, dates of those meetings.	TBD	
Well Types and TDS	**Yes**	**No**
Water disposal wells into sub-3,000 TDS?	**X (some of the wells)** (see clarification requested under "Well Class (and subtype)" above)	
Water disposal wells into 3,000-10,000 TDS aquifers?	**X (some of the wells)** (see clarification requested under "Well Class (and subtype)" above)	
Enhanced oil recovery into hydrocarbon-bearing, sub-3,000 TDS aquifers?	**X (some of the wells)** (see clarification requested under "Well Class (and subtype)" above)	
Enhanced oil recovery into 3,000-10,000 TDS aquifers?	**X (some of the wells)** (see clarification requested under "Well Class (and subtype)" above)	

Regulatory Criteria for Class II Wells: 146.4(a) + 146.4(b)(1)

Information to support a demonstration that the aquifer or portion thereof does not currently serve as a source of drinking water per 40 CFR 146.4(a)

40 CFR 146.4(a) Criteria	Submitted and complete? (If incomplete, describe information needed)
How the proposed exempted area was determined *(i.e., does it account for all past and future injection?)*	**Submitted and complete** The proposed area for exemption is the Transition Zone structural dome, which includes both oil- and water-bearing areas. As described in Section 4.1.1 of the application, the proposed area is bounded to the west by a northeast-striking fault that extends through Sections 6 and 31; to the east by a northwest-striking fault that extends through Sections 32, 33, and 4; and to the north and south by the limbs of the anticlinal fold. As described in Section 2.1 of the application, a consistent pressure gradient throughout the Transition Zone shows that the oil and water portions of the Transition Zone are part of a hydraulically-connected, continuous aquifer or "zone of pressure influence."
Lithology	**Submitted and complete** As stated on pg. 4-1 of application, the lithology is generalized as sandstone with a characteristically-low clay content, variably

	containing turbidite deposits; terrestrial sands; poorly-consolidated, friable sandstone; and very fine- to very coarse-grained sands and cobbles.
Permeability and porosity	**Submitted and complete** Transition Zone porosity and permeability values (based on core analyses from seven wells) are given in Table 1 of the application. Porosity ranges from 11.2% to 32.7% (average 26.4%) and permeability ranges from 2 mD to 4,203 mD (average 1,032 mD).
Direction of groundwater flow	**Submitted and complete** Regional groundwater flow is described in section 4.1.2, pg. 4-4 to 4-5 in the application. Pre-development shallow regional groundwater flow is illustrated in Figure 17; while flow patterns have been influenced by changing pumping patterns over time, Section 4.1.2 states that overall flow is generally from recharge areas in the surrounding uplands (in the south) to discharge areas at dry lake beds (in the north). In the Transition Zone, flow is driven by production and injection activities. As described in Section 4.1.1, there is a net-negative fluid balance in the Transition Zone. Oil is separated from produced water and the produced water is reinjected, meaning that more fluid is withdrawn from the aquifer than is reinjected. This creates an inward pressure gradient (a pressure sink) localized around the producing wells. Due to current and historic production, groundwater flow direction within the Transition Zone is currently from the edges of the dome toward the producers near the top and center of the dome.
Upper and lower confining zone(s) and description of vertical and lateral confinement from USDWs	**Submitted and complete, but not sufficient** Confinement from USDWs is described in Sections 4.1.1 and 4.1.6 of the application and summarized below. As stated in Section 4.1.6, fluids in the Transition Zone are contained by bounding faults to the east and west of the field, by the fine-grained rocks of the Chanac Formation overlying the Transition Zone, and by an inwardly-directed pressure gradient due to production activities. The application primarily relies on oil accumulation and oil/water contacts as evidence of confinement. There are a few items for which clarification/additional data would be useful, which are listed below. In particular, it is unclear whether the proposed exemption area is in communication with underlying USDWs. ***Upper/lateral confinement - Lower Chanac Formation*** As described in Section 4.1.1 of the application, the fine-grained rocks of the Chanac Formation overlying the Transition Zone serve as the upper confining zone, as well as the lateral confining zone due to the local dome structure. To the north and south, the lower

	Chanac's anticlinal limbs dip a maximum of 6 degrees in either direction, isolating oil and injected fluids in a structural trap, per p. 4-2 of the application. The application states that, "[b]ased on limited core descriptions, the lower Chanac is a very fine grained (occasionally very coarse), very silty, clayey, sometimes pebbly sandstone with variable clay content to a very silty, slightly calcareous mudstone" (p. 4-2). In the April 27, 2016 memorandum from DOGGR to the State Water Resources Control Board (referred to as the "state agency correspondence"), DOGGR writes, "No direct information is available on the Lower Chanac's permeability. The best evidence of the seal's permeability is the oil column that is present below the lower Chanac. This is a standard measure of seal strength. Otherwise, the oil would migrate upward and out of the reservoir. There are no shallower oil accumulations at this site. The Lower Chanac seal held an initial reservoir pressure of 1,160 psi throughout geologic time. The pressure of the reservoir is now at about 1,045 psi." Appendix A-1 does appear to provide three permeability and porosity data points for the lower Chanac, from a single well core: 157.3 mD permeability to air and 25.8% porosity at a depth of 2,664.5 ft; 244.2 mD and 28.7% at 2,663.5 ft; and 339.7 mD and 29.6% at 2,662.5 ft. Two XRD data points in Appendix A-2 indicate that total clay percentages in the lower Chanac are high relative to the Transition Zone (approximately 50% in the lower Chanac, compared to 7% to 13% in the Transition Zone). To ensure that the aquifer exemption application contains the most complete and up-to-date information, please confirm whether the values in Appendix A are representative of the lower Chanac. ***Lateral confinement - bounding faults*** Faults on the western and eastern sides of the area to be exempted (shown in Figures 4 and 5 of the application), are stated to be sealing due to differences in oil-water contacts on either side of the fault and offset stratigraphic contours (shown in Figure 12). In addition, regional faults to the north and south of the field, mapped by Goodman and Malin (1992), may provide additional evidence of isolation (per p. 6 of the state agency correspondence, "[t]he reference to Goodman and Malin was provided to demonstrate that there are significant faults in the region that may provide further containment," though this does not provide site-specific evidence). Based on the information provided in the application, it is unclear if the western and eastern faults penetrate the lower Chanac (and thereby fully seal off the lower edges of the area to be exempted);

	see Question B-3 of the state agency correspondence. On p. 5 of the correspondence, DOGGR replies that "Whether the faults penetrate the lower Chanac seal is immaterial: the evidence shown above [i.e., differences in oil/water contacts and the existence of a structural trap] proves that the faults are, in fact, sealing." This question from the Water Board does not appear to be fully answered. To ensure that the aquifer exemption application contains the most complete and up-to-date information, please indicate whether there is evidence related to the vertical extent of the faults or if there is any additional empirical evidence available that supports the determination that the faults are sealing. ***Lower confinement*** The Transition Zone is underlain by the Santa Margarita Formation. According to p. 4-4 of the application, pressure data indicate that the Transition Zone, Santa Margarita Formation, and upper/middle Fruitvale Formation (below the Santa Margarita) are all in hydraulic communication. No TDS or other water quality data are provided for the Santa Margarita, which is known to be a USDW in other areas of Kern County. Per p. 4-7 of the application, the Santa Margarita is not included in the proposed aquifer exemption; please clarify whether the Santa Margarita meets the definition of a USDW at this location and (if it is a USDW) why it does not require an aquifer exemption. Is flow across the lower boundary of the Transition Zone prevented solely by the inward pressure gradient?
Oil or mineral production history	**Submitted and complete** The Transition Zone has been a site for active production wells since 1946 (p. 4 of the state agency correspondence suggests that the field was originally called the "Grapevine" field in the 1940s). The application provides a summary of active transition zone wells in Table 5, a summary of cumulative production and injection volumes by well for Transition Zone wells in Table 6, and a summary of yearly production and injection volumes for Transition Zone wells in Table 7 and Figure 15. Figures 14, 20, and 21 provide maps of historic and current production and injection wells. Per p. 2-1 of the application, the Transition Zone has produced 16 million barrels of oil and 1 billion cubic feet of gas to date.
Information on drinking water wells that draw from the aquifer proposed for exemption, for which the aquifer might be a current source of drinking water	**Submitted and complete, but not sufficient** The application (including the state agency correspondence) does not identify any drinking water wells that draw from the aquifer proposed for exemption. According to the state correspondence, the state and regional Water Boards identified several water wells not originally identified by DOGGR, though none of these wells are completed in the Transition Zone. Reported depths for water wells range from 202 ft to 1,580 ft; there is approximately 1,000 ft or more of vertical separation between these depths and the depth of the area to be exempted. The closest public water supply well is

	approximately 0.9 miles from the boundary of the proposed exemption. According to p. 3 of the state correspondence, the only source of well data used was a list provided by the Department of Water Resources; no site reconnaissance was conducted. Section 4.1.4 of the application notes that "review of the [State Water Board's] GAMA database did not produce additional data." In addition, on p. 10 of the state correspondence, the Water Board notes the presence of a small residential community just outside the eastern boundary of the area to be exempted and asks about the community's water source. In response, DOGGR writes, "Our database has no documentation of the community's water supply." Additional information is requested regarding the water well inventory. Evidence of a thorough, good-faith effort to identify area water wells is needed to ensure a robust and defensible record for the aquifer exemption determination. This could include, but is not limited to, documentation of site reconnaissance, communication with well owners, or investigation of alternative data sources.
Maps of the area, geology, and hydrogeology	**Submitted and complete** A general map of the area is provided in Figure 1 of the application; Figure 2 is a topographic map of the region; Figure 9 is a map depicting the surficial geology; Figures 4 through 6 are geologic cross-sections; Figure 12 illustrates characteristics of the Transition Zone; and Figure 17 illustrates historic, regional shallow groundwater flow.
Table of inventoried water wells with owner information, purpose, depth, name of aquifer, well completion, age, and data source (including all wells tapping any aquifer in the area) ***Note: Water well owner information may be confidential***	**Incomplete** Appendix D-1 of the application includes information about water wells in the vicinity, including: screened interval (ft bgs), well ID, completion date, data source, and distance from the Tejon Oil Field. Information on additional wells was provided in response to the Water Board's questions, shown in Figure D-2 and Table 4A of the state agency correspondence. Completion date/age and formation are not included in the well inventory tables. To ensure a robust and defensible record for the aquifer exemption determination, this information should be provided if it is available. If it is not available, please indicate that this is the case. Also, see "Information on drinking water wells…" above for additional information requests related to the water well inventory. The source(s) of water for Laval Rd development should be confirmed and, following the public comment period, it should be confirmed that no concerns about additional wells have been raised.
Map showing down-gradient and	**Not provided**

hydraulically connected water wells (including all wells that draw from the aquifer proposed for exemption or any hydraulically connected aquifers)	As discussed in the "Upper and lower confining zone(s)..." section above, the application states that sealing faults and the overlying lower Chanac Formation hydraulically isolate the proposed exemption area such that no down-gradient or hydraulically-connected wells exist.
How groundwater direction and speed were determined	**Submitted and complete** Only limited groundwater flow information is provided, though, as discussed in the "Upper and lower confining zone(s)..." section above, the application states that sealing faults and the overlying lower Chanac Formation hydraulically isolate the proposed exemption area. Figure 17 of the application is a historic, regional shallow groundwater flow map depicting equipotential lines overprinted with surficial stream flow. As described under "Direction of groundwater flow" above, the groundwater flow direction within the Transition Zone is driven by the production/injection regime, and flows from the edges of the dome toward the producers near the top and center of the dome.
SWPAs and designated sole source aquifers	**N/A** Not applicable to the proposed location.
Size of the area evaluated and rationale for determining the size	**Incomplete** Figure D-2 of the state agency correspondence (with corresponding data in Table 4A) includes the most up-to-date locations of water wells within 3.25 mi of the producing limits of West Tejon, as specified on p. 4-8 of the application. However, no rationale was given for the 3.25 mi radius of the well search. Please provide a rationale for selecting this search area.
Information on the capture zone of wells in the area	**Not provided** No capture zone analysis is provided. Per the argument that the proposed exemption area is hydraulically isolated, water well capture zones would not be an essential factor for the aquifer exemption determination.
How the lifetime of the well was determined	**Not provided** This information is not supplied because no water supply wells were determined to have been completed in the Transition Zone aquifer.

Information to support a demonstration that the aquifer or portion thereof cannot now and will not be used as a source of drinking water in the future because it is mineral, hydrocarbon or geothermal energy producing per 40 CFR 146.4(b)(1)

Did the permit applicant for a Class II operation demonstrate as part of the permit application that the aquifer or portion thereof contains minerals or hydrocarbons that, considering their quantity and location are expected to be commercially producible? The items below reflect the data necessary to make the demonstration as required by 40 CFR 144.7(c)(1) and (2).

146.4(b)(1) Criteria	Submitted and complete? (If incomplete, describe information needed)
Narrative statement	**Submitted and complete** Relevant narrative information is provided in Section 4.1.5 of application.
Logs and core data	**Submitted and complete** A type log for the Transition Zone is shown in Figure 10 of the application; cross-sections are provided in Figures 4, 5, and 6 of the application; conventional core, sidewall core, and mud log drill cutting descriptions are provided for three wells in Appendix A (Exhibit A-1) and Appendix E (Exhibits E-7 through E-9). These core data confirm the presence of oil, provide evidence for the oil-water contact locations, and include oil saturation information that verify commercially producible quantities of hydrocarbons.
Maps	**Submitted and complete** Figures 2 and 3 of the application show the areal 1973 production limits of the Tejon field; Figures 4 through 6 show cross-sectional information on producing transects of the producing limits; and Figure 14 is an areal view of historic production well locations and wells with down-dip oil shows.
State issued permit	**Incomplete** While documentation associated with injection and production wells in the field is provided in Table 5 and Appendix F-1, it does not appear that a specific list of current permits is provided. Please provide this information.
Information on previous hydrocarbon production (commercial producibility is presumed) or production history of converted production wells or other wells in the vicinity	**Submitted and complete** Appendix E of the application summarizes past and present hydrocarbon production in the oil field, including lists of production wells, annual and cumulative production information, and a summary of core analyses. Table 6 describes the cumulative production and injection volumes in the area, and Table 7 describes those same metrics on a year-by-year basis. Among wells with deep completion intervals, according to Exhibit E-11, the completion elevations have ranged from -1,565 ft to -1,634 ft TVSS.
Formation description, depth, thickness and permeability or porosity (new Class II wells)	**N/A** The proposed aquifer exemption pertains to existing wells, not new wells.
Drill stem tests	**Submitted and complete** Appendix E-8 shows the formation test results (i.e., drill stem tests) of Well 17-33, a Transition Zone well, which demonstrates the presence of oil sands.
Project description	**Submitted and complete, but not sufficient** According to the project description in the application, the aquifer proposed for exemption will be used for continued and expanded

	production within the Tejon West Field, including enhanced oil recovery operations. The area proposed for exemption includes both the oil-producing portion of the field as well as a zone that is water-bearing and is not (currently) oil-producing. The application states that these two zones (water-bearing and oil-bearing) are in hydraulic communication, evidenced by the smooth pressure gradient along a local stratigraphic column (shown in Figure 11 of application). On p. 4-6, the application states that, if pressure were sufficiently reduced from future production, then "a secondary gas cap would form at the top of the West Tejon structure which would push the oil column downward into the water segment of the Transition Zone. Consequently, potentially producible volumes of hydrocarbons would then be present below the oil-water interface, meaning that the entire interval is a potential source of hydrocarbons." According to p. 1 of the state agency correspondence, the -1,690 ft TVSS contour "provides adequate lateral and vertical offset from the existing oil water contact to ensure that any waters outside the designated volume will be protected." Additional clarification is needed regarding the selection of the -1,690 ft TVSS contour as the areal boundary of the area to be exempted. What rationale/justification was used to select this elevation as the level across which there would be no flow of unwanted fluids? A general response to this question was provided in the state agency correspondence (pp. 1 and 2) but no rationale/justification for the specific value was provided. Also, p. 4-9 of the application states that injection into deeper zones (instead of the Transition Zone instead of deeper zones) would "serve to contaminate the sub-3000 parts per million water that otherwise could retain the possibility of some additional future beneficial use." Does the "sub-3000 parts per million water" in this sentence refer to the injectate? Please clarify.
If CBI is an issue, R&D project results	**N/A** Not applicable for this project.